INTERNATIONAL RICE COMMISSION

NEWSLETTER

Vol. VII, No. 2 June, 1958

CONTENTS

FOOD AND AGRICULTURE ORGANIZATION
REGIONAL OFFICE FOR ASIA AND THE FAR EAST
BANGKOK THAILAND

THE INTERNATIONAL RICE COMMISSION

The International Rice Commission was established under the sponsorship of the FAO for the purpose of promoting national and international activity in respect of production, conservation, distribution and consumption of rice, except matters relating to international trade. At present it has 26 member governments, namely :

Australia	India	Pakistan
Burma	Indonesia	Paraguay
Cambodia	Iran	Philippines
Ceylon	Italy	Portugal
Cuba	Japan	Thailand
Dominican Republic	Korea	United Kingdom
Ecuador	Laos	United States of America
Egypt	Mexico	Vietnam.
France	Netherlands	

The First Session of the Commission was held in Bangkok, Thailand, March 1949; the Second Session in Rangoon, Burma, February 1950; the Third Session in Bandung, Indonesia, May 1952; the Fourth Session in Tokyo, Japan, October 1954; and the Fifth Session in Calcutta, India, November 1956.

For technical matters the Commission has special working groups. At first the Commission began with two working parties – one on rice breeding and the other on fertilizers – organized in 1950 and 1951 respectively. In 1954 the Commission added three more working groups to work on the topics of rice storage and processing; mechanization of rice production; and soil-water-plant relationships in the production of rice.

AGRICULTURAL EXTENSION IN ASIA

C.W. Chang[1]

I. INTRODUCTION

Except for some plantation crops such as rubber, tea, coconut and sugar cane in a few tropical countries in Asia, farms are generally small, ranging from 2 or 3 acres in Japan and Indonesia (Java) to 7 or 8 acres in the Philippines and to about 12 acres in the Central Plain of Thailand. Due to the age-old custom, in most countries of the Region, of inheritance in land property by one's own descendants and the desire to have both good and poor land equally divided between them, farms are generally very much fragmented, with pieces of land scattered over a wide area. Such fragmentation of land not only creates hardships for the cultivator because he has to travel far to work in his fields, but such improvements as the installation of irrigation facilities or the adoption of some kind of farm mechanization is also made difficult. Consequently this often becomes a major source of village disputes.

Because of the smallness of farms, land is used mainly for production of crops for direct human utilization instead of for feeding livestock. What little livestock a farm may keep mainly consists of draft animals. In Thailand they are

Table 1. *Comparison of Crop Yields among Asia, Europe and the World Average for 1955*

	Yield per hectare (100 kg.)			Percentage of the	
	Asia	Europe	World	European Average	World Average
Wheat	8.5	16.7	11.7	50.90	72.56
Rye	9.9	15.1	13.9	65.56	71.29
Barley	10.9	18.9	12.6	57.67	86.50
Oats	10.3	17.3	14.1	59.54	73.05
Maize	11.8	16.3	16.7	72.40	70.65
Millet and sorghum	6.5	10.4	6.7	62.50	96.42
Rice (paddy)	18.2	42.3	18.2	43.02	100.00
Potatoes	72.8	131.4	119.7	55.43	60.08
Sweet potatoes and yams	103.3	122.9	90.6	84.05	114.02
Cotton	1.5	2.3	2.4	65.22	62.50

1 *Agricultural Adviser, FAO Regional Office for Asia and the Far East, Bangkok, Thailand.*

called buffaloes, in the Philippines carabaos, and in India bullocks. They are fed almost wholly by such farm by-products as straw, oilcakes, and weeds and grass taken from fields in normal cultivation. It is interesting to note in this connection that, outside of the India Subcontinent, most Orientals, particularly the Chinese, don't like milk. In Taiwan every farm keeps a few hogs, mainly for manure production.

The crop yields in Asia are low, as shown in Table 1, based on FAO statistics for 1955.

In comparison with the crop yields in Europe, yields in Asia are low. With the exception of paddy and sweet potatoes and yams, Asia is also much below the world average. Even in Asia the difference in crop yields between the various countries is also very great. For instance in 1955, according to FAO figures, rice yield per hectare in Japan was 4,810 kg.; in South Korea 2,790 kg.; in Taiwan 2,680kg.; in the Federation of Malaya 1,950 kg.; in Indonesia (Java and Madura) 1,650 kg.; in Burma 1,480 kg.; in Thailand 1,430 kg.; in Ceylon 1,420 kg.; in India 1,260 kg.; in Pakistan 1,240 kg.; in Vietnam 1,230 kg.; in the Philippines 1,190 kg.; and in Cambodia 1,180 kg. This shows that there exists considerable room for improvement in the low yielding countries.

Low literacy rate in most countries of the Region is another serious obstacle to rapid agricultural improvement. In this connection, Japan is an exception. Its compulsory education covers 9 years, including 6 years of elementary education and 3 years of junior middle school education. Taiwan is a close second. In some other countries of the Region the literacy rate is as low as 20 per cent. The situation is further complicated in those countries where several languages are used.

Most farmers in the Region really work hard in order to make both ends meet. One Chinese proverb says, "They start to work when sun rises; they quit only at sun set". They toil all day long. It is only in the tropics where life is comparatively easy that people prefer to take their time leisurely.

It is against this general background that all countries of the Region are now developing their agricultural extension services for the increase of agricultural production and the betterment of rural life.

II. EXTENSION – ITS MEANING AND IMPORTANCE

Agricultural extension can be defined as a government effort to bridge the gap between agricultural research stations on one hand and the farming population on the other, by establishing suitable teaching organizations at the various levels of administration, so that the results of research can be systematically "*extended*" to the farming population for wide application, and so that their farm problems can be quickly brought back to the research stations for study and solution. This provides a two way traffic – from the government to the people and from the people to the government – for the increase of agricultural production, and consequently the advancement of the economic well-being of the people as a whole.

In order to carry out extension work effectively, the following conditions must be satisfied:

1. That all agricultural research stations be substantially strengthened and their research projects geared to the pressing needs of the farmers, in the hope that there can be a continuous flow of useful knowledge and skills to the extension workers for use in their teaching to the farmers. It is likely that there already exists a wealth of information accumulated in most countries of the Region as a result of years of research and of the technical assistance rendered by the various international aid agencies, that should be made available in a form or forms that average farmers can use. It is not uncommon to see that the farm of a more successful farmer outyields that of his neighbours by a high percentage. This is the place where an extension worker can be very useful. He should organize farm study tours, pointing out why certain fields have better yields, and trying to assist the less successful farmers to attain similar results.

2. That a workable extension service be established in the government so that its views and needs can be heard and considered at the policy-making level of the government, and that extension education be carried out adequately at the village level, on a nation-wide basis.

3. That there must be the kind of extension program that the local people can consider their own, and be willing to carry out. At present many countries of the Region have long range programs of development such as the second 4-year plan of Taiwan (1957-1960) and the second 5-year plan of India (1956-61). Extension organizations should help to implement these. In this case the government will make necessary provisions for extension supplies, but it is absolutely important that such a program be thoroughly discussed by the villagers themselves, to the extent that they can understand it and are willing to support it.

4. That extension must be educational, and separate from government inspection and regulatory functions, in order to win the confidence of the farmer in the extension worker whose advice he will then take without suspicion. It would be difficult for an extension worker to act one day with a whip in his hand and another day with helpful advice. However, close cooperation between inspectors and extension workers is desirable.

5. That an extension worker must be able to use as many different methods of extension teaching as possible to get his message to the people. The greater the number of contacts he has with a subject, the greater are the chances that

he will be able to put a recommended practice into general use.

6. That extension workers must be well trained and reasonably treated so that they can stay on the job to insure steady progress in extension work.

7. That extension workers must be assisted by a team of subject matter specialists, who can keep them informed of recent research development and assist them in their technical teaching to the farming population. In so doing they will discover new problems and pass them on to the research people for investigation and solution. In this way they tie research and extension together and make both of them more effective.

Agriculture is the basic industry of a country. It supplies our food, our fiber and our building materials. When agriculture progresses, more supplies will become available with fewer people in farming, thus making it possible for cities and manufacturing industries to grow. At present in most countries of the Region, 8 out of 10 people are engaged in farming and still there is a deficiency. In the United States of America, one farm worker provides for himself and twenty others, still having a surplus for export. Without this progress in farming efficiency, the present development of big cities and manufacturing industries in the States would not have been possible.

III. PRESENT STATUS OF EXTENSION DEVELOPMENT

Agricultural extension as a regular government service is still in the early stage of development in most countries of the Region. Its slow development is due to many reasons. Two of them may be mentioned here. One is that education including agricultural education has been and still is very academic. Once Confucius said "I am not equal to experienced farmers". Many agricultural graduates unfortunately belong to this category and would not be much help to the farmers in their daily farm activities. In fact, many of them prefer office work to field operations. The other reason is that a ministry of agriculture or a department of agriculture usually does not get the kind of recognition from the government, that is commensurate with its importance. Either it does not have enough appropriations for research, education and extension on a scale that is desired, or it operates on a comparatively low pay scale and thus cannot keep men on its staff to insure continuity of the work.

After World War II many countries of the Region became independent and are aware of the needs of their people. Especially during the period of food shortage following the War, most countries have been endeavouring to increase food production and to raise the standards of living of the average citizen. As a result, many countries of the Region have begun, during the past decade, to organize extension services or to expand those existing.

However, the development of a sound system of extension must necessarily be a slow process, as it involves the training of personnel, the setting up of a workable organization, the appropriation of funds, the changing of attitude of the farming population etc. All these require time to accomplish. But progress can be accelerated if one is willing to profit by the experience of others. This is the purpose of the present review of extension development in the Region.

A. A General Review

In reviewing the present status of agricultural extension development in the Region, the following characteristics become readily apparent:

1. Types of administrative organizations. Extension services in the Region have developed administratively along three broad lines:

1) **Centralized type** - This can be represented by Thailand, Burma and Ceylon, where all extension workers are employed by the central government and assigned to work in the provinces or other governmental sub-divisions as the case may be.

2) **Decentralized type** - This is the case in Japan and Indonesia, where extension is the responsibility of the prefectural or provincial governments, with some financial and technical assistance from the central government.

3) **Cooperative type** - This is found in India and Pakistan, where the central government is federal with the states assuming full responsibility for extension, and any activity in the state can be conducted only by mutual agreement.

These are the broad lines of development and, of course, there are variations between them. In Taiwan, the extension service is a cooperative undertaking between the government and the farmers' associations, which are a private organization. The extension organization must be developed to fit local conditions. In general, it can be said that the centralized type of extension administration provides more chances for staff promotions and adjustments and more uniform assistance to different parts of the country, while the decentralized type permits more local initiative and local adaptation.

2. Tendency towards a unified system of extension. With the exception of a few countries, such as Japan and the Philippines, extension work is often carried out by a number of government agencies, largely on a commodity basis. This is the way in which extension work has been usually developed. Unavoidably, this multi-system of extension entails a certain amount of duplication and friction, and therefore a waste of money and personnel. This should be avoided, especially in developing countries where trained personnel is scarce. It is encouraging to note that there is a growing tendency for governments to move in this direction.

3. Tendency towards a comprehensive program of extension. Invariably, extension work begins with such things as improved seed, seedlings, fertilizers, farm tools and equipment, pesticides etc. As time goes on, it gradually expands to include work on livestock improvement, animal disease control, soil conservation, crop rotation etc. Finally, the time will come to consider the farm as a whole. How can the farm be used to the best advantage? How can the farm produce be disposed of economically? Extension often starts with the problems of agricultural production but soon branches out into the field of economics. Such questions as the cost of production, marketing, storage and the use of credit will receive increasing attention in the extension program, as agriculture becomes more prosperous.

Extension work does not end with farm improvement. This is only a means to an end. It is also concerned with farm home improvement and rural youth training, in order that the standard of living of the farm family can be raised and that young people can be trained for future leadership.

One good example of this comprehensive approach to farm and home improvement can be found in the Philippines. There, the Bureau of Agricultural Extension has separate sections for its agricultural program, its home economics program and its rural clubs program.

4. Tendency towards a closer relationship between extension and research. By definition, extension bridges the gap between knowledge and practice; that is, between research workers and the farming population. Extension without research is like a well without water. It is empty.

A good illustration of such close relationship can be found in Japan, where research and extension are administered by one bureau at the national level and by one department at the prefectural level. To link up the village level extension workers with the research people, there is a team of subject matter specialists, who are often stationed on research farms, so that they may keep themselves abreast of research findings and pass them on to the extension workers in a form suitable for wide application. Similarly, these specialists bring back extension problems to the research farms for study and solution. This give-and-take process forms the basis of a prosperous and expanding agriculture.

5. Tendency towards a closer relationship between extension and formal education. Because of the shortage of trained personnel for extension service, there has been recently in many countries of the Region, an increasing amount of cooperation between extension services and agricultural institutions of higher learning. A good example of this is the University of the Philippines College of Agriculture, at Los Banos. Here there is a department of agricultural education which offers major courses in both agricultural education and agricultural extension. It is planned to offer post-graduate courses in extension, beginning from 1959.

6. Extension and community development. Since 1952, the Government of

India has undertaken community development projects on a tremendous scale, trying to improve all aspects of life on a community basis. This is based on the philosophy that life is an organic whole, and that the improvement of one aspect of life cannot be very successful without the improvement of others. Since then, some other countries of the Region such as Pakistan and the Philippines have taken up the work to some extent.

Depending upon the stage of social and economic development of the country in question, community development can be accomplished either by an informal coordination of development plans of the various government agencies concerned to insure a balanced program of development, or by the establishment of a formal body to carry out a coordinated plan of development in an integrated way through the employment of multipurpose village-level workers. If the latter method is adopted, care should be taken to see that, as soon as the situation has progressed to a certain stage of development, more specialized services at the village level should be made available. It is, therefore, important for those countries that have adopted the latter method to make sure that a suitable system of agricultural extension service at the village level is developed at an appropriate moment. In fact, an agricultural extension worker is himself a generalist or a multipurpose worker, because he has to advise farmers on all aspects of farm improvement work, including problems of plant and animal production, water and land use, and marketing situations. It is obvious that it would be impossible to expect a multipurpose village-level worker in an advanced stage of development to be able to serve well on problems of rural development such as agricultural improvement, health, sanitation, cooperatives, cottage industries, and local government.

B. Individual Country Reviews

Burma. In Burma, extension work was started as early as 1914, with a few people trained in India. Since the establishment of the Agricultural College at Mandalay in 1924, more people have been trained and extension work has been gradually expanded.

The system of rice seed multiplication and distribution in the country is considered one of the best in Asia. The improved seed from the agricultural research stations is first multiplied in government major seed farms and then in government minor seed farms, located in different parts of the country, before being allotted to private seed growers for a large scale multiplication and final distribution for general cultivation.

The government major seed farms are established one in each district, with an area ranging from 150 to 500 acres each. The total area for these major seed farms is about 16,000 acres. They are equipped with seed godowns, each with a capacity of about 200 tons. The minor seed farms are located one in each township, with an area ranging from 25 to 400 acres each. On these there are no storage facilities. It was reported in 1957 that about 1,200,000 acres of land were planted to the improved seed thus

distributed, out of nearly 9,000,000 acres under rice cultivation.

Extension work in the country is organized on national, circle, district and township levels. In each of the 8 circles into which the country is divided, there is one agricultural research station, and on each station there is an agricultural school to train farm boys at the rate of 50 boys a year, all with government subsidies.

Recently, the Extension Division in the Department of Agriculture has taken on a large number of the so-called "organizers", trained by the Ministry of Social Welfare, to deal with social problems and general publicity among the farmers, leaving the matter of technical agriculture to the care of the extension people. This division of work between the two groups of people has not proved very satisfactory.

Ceylon. In Ceylon, extension work has evolved—and is still evolving—from the agricultural advisory service instituted by the British Colonial Government. It is now undertaken by five different agencies: two governmental and three private.

The Department of Agriculture in the Ministry of Agriculture and Food is located at Peradeniya, Kandy, for both agricultural research and extension. Extension activities are carried out by divisional agricultural officers, each in charge of a province, assisted by about one hundred agricultural instructors stationed in different parts of the country. These officers and instructors are each provided with several demonstrators or overseers.

Some years ago a Department of Food Production, staffed with food production officers, whose duties are similar to those of the agricultural instructors, was created in the same Ministry. These officers, together with overseers, are stationed in various areas of the country.

Under the direction of the divisional agricultural officers, these two groups of field officers conduct demonstrations, teach improved farm practices and arrange competitions and agricultural shows for the increase of food production.

In addition, there are three Small Holdings Advisory Services, concerned with the three export crops—tea, rubber and coconut—and attached to their respective research institutes. Each of these services is the equivalent of an extension service, complete with publications, visual aids and educational programs.

In recent years, much attention has been given to the organization and development of young farmers' club work.

China (Taiwan). Agricultural extension in Taiwan is a cooperative undertaken between the Provincial Department of Agriculture and the Provincial Farmers' Association, with financial and technical assistance from the Chinese-American Joint Commission on Rural Reconstruction. The Provincial Department of Agriculture, by virtue of its position, provides general supervision and the services of subject matter specialists, and is concerned with extension programs and policies, while the Provincial Farmers' Association is responsible for program implementation.

In order to carry out the work smoothly, agricultural extension advisory committees are organized at the provincial, county, township and village levels, with the principal government official serving as chairman, and the chief officer of the farmers' association of the corresponding level serving as secretary. These committees are composed of representatives from relevant government agencies, private organizations and farm leaders, for the purpose of coordinating extension efforts and the adoption of extension programs.

Taiwan is now in the midst of its second four-year plan (1957-1960). Cooperative extension is therefore largely concerned with the implementation of government production programs at the village level.

The most successful farmers are selected from each village by the Provincial Farmers' Association at the beginning of each year as the "model" farmers of the village in rice, sugar cane, wheat, hog or poultry production. By using all improved methods, the "model" farmers can increase crop yield by 20 percent more than their neighbours. One "model" farmer in Pingtung Prefecture, Taiwan, produced 5,802 kg. of brown rice per hectare from the first crop of rice in 1957 as against the average yield of 3,302 kg. for the same township. On Farmer's Day, February 4th, the governor of Taiwan gives prizes to each "model" farmer. Of course, they are very proud of these prizes. This helps to boost production.

India. Since India has a federal form of government, agricultural extension is the responsibility of the states. In May 1955, the Directorate of Extension and Training was set up in the Union Ministry of Food and Agriculture, under the direction of an agricultural extension commissioner, assisted by a director of extension and training. This Directorate was transformed from a former wing office of the Indian Council of Agricultural Research.

As its name implies, the Directorate of Extension and Training has as its functions (1) preparation of national training schemes for community development and extension services blocks; (2) drawing up model training programs for adoption by state governments; (3) examining the training plans submitted by the state governments on the basis of the model programs, and issuing financial sanctions; (4) preparation of literature for village level workers; and (5) organizing crop competitions in the country. The Directorate administers the extension training center at Nilokheri and arranges distribution of equipment obtained through foreign aid among the different training centers in the country.

Extension in India means a total approach to all the problems of rural development through the multipurpose village-level workers, and agricultural extension is just a part of the coordinated approach.

The Department of Agriculture in Uttar Pradesh may be taken as an illustration of how agricultural extension work is generally carried out in the country.

The Department is responsible for agricultural research, education and extension in the State. The State is divided into 10 regions, 51 districts and a number of national extension service blocks. By the end of 1957, 357 national extension service blocks had been established. Each region is headed by a deputy director of agriculture, and each district by a district agricultural officer. Recently, one additional district agricultural officer has been added to each district for emphasis on extension education. In the State there are 51 seed farms and 476 seed stores. Those areas in the State that are not presently covered by the national extension service blocks are served by the agricultural inspectors of the Department. In 1957 there were 668 agricultural inspectors in the State, concerned with both regulatory and educational matters.

Indonesia. Agricultural extension in Indonesia was first started in 1911 during the Dutch occupation. It is organized on the national, provincial, regency, district and sub-district levels. In the Ministry of Agriculture at Djakarta there is a People's Extension Service. The actual carrying out of extension work is the responsibility of the provincial governments. The total extension force in the country is about 7,000 people, mostly with only six years of schooling. To raise their standard the Government has set up a number of training centers for extension workers. Candidates with successful records after a minimum of five years of extension service are selected and sent to these centers for training for one year on government subsidies.

One of the outstanding features of extension work in the country is the importance given to adult education. Since 1950, about 200 village educational centers have been established, each in charge of an extension worker, who lives in the center. These centers are considered centers of village communities, and are used for social, educational and agricultural purposes.

There are now about 1,900 farmers' training courses in the country, ranging from 6 to 12 months each. There is also a total of 83 two-years' vocational schools in agriculture for rural youth.

Another important feature of extension in the country is the establishment of pure seed farms. In 1956 about 250 such farms were in operation.

Japan. Extension work in Japan was first started by farmers' organizations, and later taken up by the government and expanded. Due to the high rate of literacy, extension teaching is readily accepted by the farming population. It is reported that more than 85 per cent of the six million farm families in the country have received some benefits from the extension activities.

One of the chief characteristics of extension in Japan is the close cooperation between research and extension at all levels of administration, which helps to make the work of both more meaningful and useful.

Extension work in the country is comprehensive, covering all the advisory work that is concerned with farm and home improvement and rural youth

training, except for forestry, fisheries and sericulture, which are served by other government agencies.

Another commendable feature is the stationing of farm advisers in groups in local extension offices, with each serving on the average about 600 farm households in a rather compact area. This is a manageable size for each farm adviser. By working together as a team, they can discuss common problems and receive inspiration from each other.

Last, but not least, mention should be made of the rural youth training program in Japan. Rural boys – mostly the first sons of the farm families – and girls, after the completion of their normal compulsory education, may enter one of the farm youth training farms in the country for one or two years, for practical training in farm and home work. After graduation they go back to their parents' farms and become youth club leaders and in time leaders in their home communities.

Korea. In 1926 during the Japanese occupation, all kinds of farmers' organizations in Korea were combined into one, known as the Korean Agricultural Association, for the promotion of food and agricultural production. Although the methods used were dictatorial, something had been accomplished. All agricultural plans were laid out by government officials, and administered by them, with branches of the Association handling the supply of seeds, fertilizers, farm tools and equipment. In the meantime, a Federation of Financial Associations provided credit for the farmers. Furthermore, there were model villages set up as examples of village improvement. At one time, there were over 15,000 agricultural workers employed by the Government and the Korean Agricultural Association.

In 1948 during the military occupation, an agricultural extension service was created in the center, to supervise agricultural research and extension work in the country. For the first time in history, extension work was placed on the right track, but it was short-lived as a result of the Korean War which began in 1950. However, the 4-H Club work started by the service did take root and grow.

In February 1957, three important acts–the Agricultural Extension Act, the Agricultural Cooperative Act and the Agricultural Bank Act–were promulgated. As a result, an Institute of Agriculture was created in June 1957, by transforming the former agricultural technical institute at Suwon, and an agricultural bank started operation in April 1958.

The Institute of Agriculture consists of two major bureaus, namely: the Bureau of Agricultural Research and the Bureau of Agricultural Extension, thus bringing agricultural research and extension under one administration. Under the extension bureau there are separate sections for farm improvement, home demonstration, farm youth and technical dissemination. Similarly, provincial institutes of agriculture were established in the provinces. The immediate effort is to recruit and train enough personnel to man these institutes and to carry out extension activities on a nation-wide basis.

Pakistan. Like India, Pakistan also has a federal form of government, and so agricultural extension is the responsibility of the two States—East and West Pakistan.

In the Ministry of Food and Agriculture in East Pakistan, there are two directorates - Directorate of Agriculture for Research and Instruction, and Directorate of Extension and Rural Development.

The State is divided into 4 agricultural circles, each under the care of a deputy director. These circles are further divided into districts, subdistricts and Tanas. In each circle there is a seed multiplication farm of about 200 acres. In addition, there are in the State, 14 district seed farms with the average size of 20 acres each, over 200 demonstration farms and about 60 seed stores, to supply farmers with improved seeds of all kinds, manures, chemical fertilizers and small farm implements.

The Government of East Pakistan has employed several thousand extension people, largely concerned with the licensing and field inspection of jute production.

The Department of Agriculture in West Pakistan has five regional extension offices, each under the care of a deputy director of agriculture. Each region is divided into circles, districts, Teshils or Tanas, and centers. They are administered by assistant directors of agriculture, extra assistant directors of agriculture, agricultural assistants and mukuaddams, respectively. Each mukuaddam looks after a center of about 100 villages.

Philippines. The Bureau of Agricultural Extension was constituted in July 1952, under the Department of Agriculture and Natural Resources, for the purpose of consolidating, coordinating and expanding agricultural extension work of the Department and of other government and private agencies undertaking extension work in rural areas. This unified system of extension on the part of the government is very much desired.

Extension work in the country is organized on the national, district, provincial and municipal levels. At the national level, the Bureau, under the direction of a director and two assistant directors, has seven divisions: (1) administrative services, (2) public relations, (3) evaluation and training, (4) specialists services, (5) agricultural program, (6) home economics program, and (7) rural clubs program. This set up includes all essential administrative units necessary for effectively carrying out a comprehensive program of extension.

In the Department of Agriculture and Natural Resources there is an Office of Agricultural Information acting as a service unit for all the bureaus under the Department. It is divided into publication division, press and radio section, visual section, production section, distribution section and library. The Bureau of Agricultural Extension prepares teaching materials and turns them over to the Office of General Information for publication and distribution.

Club work with rural women and rural youth appears to be more fully

developed in the Philippines than in any other country in Asia. This may be partly explained by the fact that 93 per cent of the people are Christians and therefore are used to group life and group activities.

Thailand. Agricultural extension was, at first, largely concerned with distributing seed, introducing modern farm equipment and collecting crop production figures. In 1952, with the help of FAO and ECA (now ICA) specialists, a four-year agricultural extension plan (1952-1955) was developed, stressing the importance of the following principles:

1. To concentrate government effort on a few extension centers for demonstration and training purposes in the first few years and then to expand the work as rapidly as circumstances permit.
2. To maintain a closer contact with research workers and promote a continuous flow of useful knowledge and skills for extension purposes.
3. To consider extension as an informal education, separate and distinct from the regulatory and administrative functions of the government.
4. To consider the farm and home as one unit for improvement, and to expand the extension service to include farm improvement, home demonstration and youth work.
5. To develop a unified system of extension for the country in order to increase efficiency and avoid duplication.

These principles have been followed very closely by the Agricultural Extension Division of the Department of Agriculture. There are now eight pilot extension centers set up: two in the north, one in the south, two in the northeast and three in the central plain. There is also a plan under way to consolidate all extension work of the Ministry of Agriculture into one unit.

The University of Agriculture at Bangkhen now offers courses in agricultural extension and home economics. This means that more qualified people will be made available for extension and that work in home economics can soon be started.

IV. FUTURE EXTENSION DEVELOPMENT AND INTERNATIONAL COOPERATION

For the further development of agricultural extension in most countries of the Region, international cooperation is urgently required, in order to provide technical advice and financial assistance as well as inspiration. This can be discussed under the following subheadings:

A. Personnel Training

This is the bottleneck of the whole problem. In practically every country of the Region there is a shortage of well trained personnel for extension purposes. This includes not only field level workers,

but administrators and subject matter specialists. The following is a brief description of some of the measures designed to achieve the end.

A regional center or centers for training extension teachers. It is absolutely important from the standpoint of economy and suitability for the Region to have one or two regional training centers, to which countries of the Region can send some of their senior extention people for training. These may then return to start national training centers and to train field workers in their home countries. The University of the Philippines College of Agriculture, at Los Banos, is now ready to make its training facilities available for this purpose. Many students from several of the South-East Asian countries went to Los Banos for training in agriculture before World War II. During the War, the campus was very much damaged. Since the War, however, with the assistance of the American aid agency and the cooperation of Cornell University, New York, U.S.A., the College has not only been fully rehabilitated, but also has been expanding. About 3,150 students were enrolled in 1957.

As mentioned earlier in the paper, the College of Agriculture has a Department of Agricultural Education, which offers a major course in agricultural extension. Beginning from 1959, post-graduate courses in extension are expected to be added.

At the invitation of the Government of the Philippines and in accordance with the recommendation of the agricultural extension meeting, held in Bhopal, India, in December 1955, FAO conducted the Agricultural Extension Training Center for Asia and the Far East at Los Banos from 11 April to 24 May 1958, with financial assistance from the Council on Economic and Social Affairs and the United Nations Technical Assistance Board. It was attended by 18 representatives of 12 countries and territories of the Region. The purpose of the Training Center was to train extension teachers, with the hope that they, upon returning to their home countries, could initiate national training programs for field level extension workers under their local conditions. This kind of cooperative arrangement for making the College at Los Banos a regional center for training extension teachers will no doubt continue for a number of years.

National extension training centers. National training centers should be attached to a regular training institution in a country, such as a college of agriculture or a secondary school of agriculture. This training institution, having been strengthened by the operation of the short term courses, would be enabled to take up the training project later, as part of its regular teaching program. It is not uncommon in the Region to see short term training courses conducted separately, with no reference to the regular training institutions already in existence. This would indicate a lack of cooperation and coordination.

In the long run, it is essential that there should be at least one good training institution for undergraduate work in agriculture in each country of the Region.

It must be reasonably well staffed, well equipped and well financed in order to be able to do the job that is required of it.

Agricultural extension study tour. In 1957, FAO organized an agricultural extension study tour to cover Japan, the Philippines and India for a total of six weeks, with 21 participants representing 12 countries and territories in the Region. This study tour was considered most successful, because it was well planned and well executed. The participants could see all that they wished to see, and there was always the possibility of a thorough discussion in each place or organization visited. Before leaving each country, copies of reports were made available for discussion with the representatives of the host government to ensure that observations were correct. As a result, not only the participants learned a good deal, but the host governments also benefited by the observations made. This proves the value of having such a study tour organized in the Region, where the situation in all countries is more or less similar. What was learned from the trip in these three countries could be easily adapted in other countries of the Region.

B. Regional Meeting

Thus far, the following extension meetings were held in the Region:

1. The First East Asian Extension Workshop was held in Manila and Baguio, the Philippines, from 20 February to 4 March 1955, under the auspices of the International Cooperation Administration of the government of the U.S.A. It was attended by representatives of China (Taiwan), Indonesia, Japan, Korea, Laos, the Philippines, Thailand and South Vietnam.

2. The FAO–sponsored Agricultural Extension Development Center for Aaia and the Far East was held in Bhopal, India, 5–15 December 1955. It was attended by representatives of Ceylon, India, Indonesia, Japan, Federation of Malaya, Nepal, Thailand and South Vietnam. The meeting produced a series of conclusions and recommendations. These recommendations now serve as the guide lines for FAO to assist member governments of the Region in the further development of their extension work.

3. The ICA–sponsored Far East Rural Youth Conference was held in Bangkok, Thailand, 11–22 February 1957. It was attended by representatives of Cambodia, China (Taiwan), Indonesia, Japan, South Korea, Laos, Nepal, the Philippines, Thailand and South Vietnam.

Regional meetings, such as these listed above, could be very useful if they were well planned and well conducted. For each meeting held, there must be a well thought-out agenda, on which each item listed must be supported by a well prepared working paper to serve as a guide in discussion. If necessary, the attendance could be broken up into groups for intensive discussion. During

the meeting long speeches should be avoided. A few experienced people should always be present to serve as resource persons. At the meeting the participants should not only be able to exchange their experiences among themselves, but oftentimes new ideas or new methods would be evolved as a result of the group thinking. Moreover, the friendship cultivated among the participants during the meeting would help to make matters of regional cooperation more feasible.

C. Extension Publications

Since extension is a comparatively new undertaking in the Region, there is a dearth of reading material on extension based on local conditions. Beginning from 1957, FAO has been issuing a semi-annual publication, "Extension in Asia", on the request of its Member Governments. This is the only regional publication of its kind. Previously, "Asian Extension News Letter" was published for two or three years by the Office of Agricultural Information, Department of Agriculture and Natural Resources of the Government of the Philippines, in cooperation with the International Administration Cooperation of the Government of the U.S.A. But it has been suspended. The usefulness of the FAO publication could be immensely increased if FAO were financially able to circulate it as widely as possible among all the people concerned in all countries of the Region. It should reach not only extension workers, agricultural administrators and agricultural teachers but even a few legislators and politicians, who are concerned with government finance control and policy making. It would thus become a medium of education for all concerned.

In the Region one may often find interesting extension activities in isolated places. Should such activities be made known to others, they could be readily adopted. This is one thing that an international agency, such as FAO, can do. Such case studies, which should include accounts of both failure and success, would prove to be of value to all extension workers.

FAO has been requested to prepare a text book on extension for use in the Region. This will be a real contribution towards the further development of extension in the Region when it is made available.

D. Extension Supporting Measures

There are a few measures that will help to make extension work much easier. Two of them are described here.

One is the setting up of farmers' organizations, which usually play a very important role in agricultural improvement. This is particularly so in the Region, where farms are small and numerous and extension workers are few. As mentioned earlier in the paper, in Japan one extension worker will have to serve on the average 600 farm households, while in India one multi-purpose village level worker will have to cover from 8 to 10 villages of about 100 families each. In some other countries of the Region, even more farm families will have to be served by one extension worker. In view of transportation difficulties in most rural areas in the Region, this is a formidable task. It is impossible for the extension

worker to make contacts with all the farmers individually, and therefore he must work with them in groups.

Two kinds of farmers' organizations can be given here as examples. One is the agricultural cooperative associations in Japan, and the other is the farmers' associations in Taiwan. Both are bona-fide farmers' organizations, systematically organized throughout the country. They are all for multipurposes, handling credit, deposits, marketing, farm supplies, storage and processing. In Japan and Taiwan these organizations handle seed distribution and sales of farm supplies, such as fertilizers, pesticides and farm tools, thus relieving extension workers of these responsibilities, and enabling them to devote their full attention to educational activities.

In Taiwan, there are several thousand agricultural units organized at the farm level by the farmers' associations. The extension worker thus meets the farmers in their groups as well as on personal farm visits, which makes his job much easier.

In some other countries of the Region, the extension worker finds it necessary to organize some *ad hoc* farm groups, such as farm study groups or farmers' clubs. They are helpful, but the ultimate goal should be for each country to have a suitable kind of permanent farmers' organization that would serve the needs of all the farm families in the country.

Much of the extension worker's assistance to villages will be productive only in cooperation with such organizations as described above, to provide credit, supplies and marketing facilities. Extension workers should be familiar with them and learn how to work with them.

The other consideration is the problems arising from land tenancy. In many places it is a serious obstacle, and stands in the way of agricultural improvement. It is reported that farmers in certain areas refuse to weed their rice fields on the ground that they will receive only one half of the benefit from the weeding, and that the amount of gain is not sufficient to cover the labour cost. There is no inducement for intensive cultivation.

In this connection, Taiwan presents a different picture. Since the land reform, the number of owner-cultivators and part-owner cultivators has been raised from 57 per cent to 79 per cent, the tenancy situation has been very much improved and the land rent fixed. Any increase in yield belongs to the cultivators. As a result, the cultivators are willing to use more fertilizers, adopt better methods of cultivation and practise pest control measures. In some areas four crops are grown a year, including two crops of rice, one crop of wheat and one crop of vegetables. The usual yield per hectare is 4,500 kgs. of brown rice for the two crops and 1,800 kgs. of wheat. This is the highest yield per hectare a year in the world.

References:

1. FAO Report on the Agricultural Extension Study Tour for Asia and the Far East, 4 November to 14 December 1957.

2. FAO Report on the Agricultural Extension Development Center for Asia and the Far East, Bhopal, India, 5-15 December 1955.

3. ICA Report on the Far East Rural Youth Conference, Bangkok, Thailand, 11-22 February 1957.

4. Proceedings of the First Asian Extension Workshop, Bureau of Extension, Department of Agriculture and Natural Resources, Manila, Philippines, 20 February to 4 March 1955.

5. Kelsey, Lincoln David and Cannon Chills Hearne, Cooperative Extension Work, Comstock Publishing Company, Ithaca, New York, 1949.

6. Brunner, Edmund des. and E. Hsin Pao Yang, Rural America and the Extension Service, Bureau of Publications, Teachers College, Columbia University, New York, 1949.

7. Methods of Agricultural Extension (A series of lectures on extension), Agricultural University of Wageningen, the Netherlands, 13 July–8 August 1953.

8. C.W. Chang, Impressions of Agricultural Extension Work in the United States of America, International Rice Commission News Letter, Vol. VII, No. 1, March 1958.

9. Lewis, A.B., Ralph W. Phillips and J. Lossing Buck, Essential Steps in National Agricultural Improvement. FAO, April 1950.

10. Shen, T.H., Agricultural Planning and Production, Committee D, Economic Stabilization Board, Executive Yuan, Republic of China, Taipei, Taiwan, March 1958.

11. Chang, H.T., Land Reform and Other Factors Contributing to Rice Production Increase in Taiwan, International Rice Commission News Letter, Vol. VI, No. 3, September 1957.

PADDY SOILS[1]

R. Dudal
FAO Soil Survey Expert[2]

I. INTRODUCTION

For the cultivation of paddy the soil is usually kept submerged, or at least saturated with fresh water throughout the growing period of the crop. Soils, which are maintained in an artificially flooded condition, often undergo some profound changes, principally the following three:

1. Movement of iron and manganese compounds out of the upper layers and subsequent reprecipitation of them underneath;
2. modification of the land surface by terracing (in sloping areas); and
3. accumulation of silt by irrigation water on the top of the original soil.

These changes may occur over extensive areas including a wide range of soils and under various climatic conditions. The morphology of the transformed soils shows the characteristics acquired because of human interference as well as those inherited from the original profile. Thus "paddy soils", although having some definite features in common, are very much diversified by the properties of the different soils of which they are composed. Consequently they should not be dealt with as one group and their management and fertilization should vary with their compositions.

II. TERMINOLOGY

The term "paddy soils" is very unsatisfactory when used as the name of a soil group. Being currently used for soils on which irrigated rice is cultivated, it merely gives an indication of the landuse but it does not give any precise information on the soil itself. In some cases the name has been limited to those soils which have undergone some changes due to irrigation practices. It is in this sense that the term is used here, although it is realized that this still covers too large a range of soils with no reference to their origin. A more suitable term is expected to be worked out.

III. GENESIS AND MORPHOLOGY

When a soil is submerged, reduction of the top soil starts through the metabolism of anaerobic bacteria. The upper few centimeters may remain in an oxidized stage due to the oxygen supplied from the irrigation water. In the reduced zone iron and manganese compounds are mobilized and carried downwards by percolating water. These compounds are reoxidized by the oxygen present in the subsoil and precipitate. The accumulation layer is 5 to 20 centimeters thick and is formed at

1. *Presented at the First South East Asian Soils Conference, Manila, December, 1957.*
2. *At present attached to the Soil Research Institute, Bogor, Indonesia.*

a depth ranging from 20 to 60 centimeters according to the texture and the permeability of the soil. As manganese is more readily reduced and more soluble than iron it moves first and generally underlies the iron precipitate. This accumulation forms concretions or coatings in fissures. The degree of development ranges from some streaks and mottles to a compact or cemented layer. Due to reduction and downward movement of iron and manganese, the upper layers of the profile become of a lighter colour. The following data from F. Koenige (15) reflect the morphology of a "paddy soil" formed on a Reddish Brown Latosol in West Java:

	Depth in cm.	Fe_2O_3%	Mn_3O_4%	pH H_2O
Topsoil	0–15	7.6	0.06	5.2
Ploughpan	15–22	3.8	0.16	5.2
"Fe" layer	22–26	19.4	0.09	5.0
"Mn" layer	26–40	16.4	0.45	5.1
Subsoil	60	8.6	0.11	5.5

The compaction mentioned above as "ploughpan" may occur in the upper layers of "paddy soils" as a consequence of the break down of aggregates by continuous flooding; it is not necessarily related to ploughing.

In terraced land the original soil has been very much disturbed. Part of the soil has been removed from the upper side of the terrace and placed on the lower side. Generally speaking, such main characteristics as texture, colour, pH, base saturation, absorptive capacity and aggregation are maintained. Only when the terraces are cut deep, parent materials may be reached, thus creating new soil conditions, especially in the upper half of the terrace.

When considerable amounts of silt are deposited successively by floods or irrigation water, the "paddy soil" formation process may start again in the fresh material, with the profile showing several superimposed accumulation layers.

From the dicussion above it appears that the important factors, which govern the formation of "paddy soils", are:

1. Reduced conditions which are favoured by poor drainage, low pH and the availability of organic matter;
2. the presence of a fair amount of iron and manganese compounds; and
3. the possibility of downward percolation.

It appears that "paddy soils" are more readily formed on acid than on basic materials. Changes occuring in the latter may be less noticeable but are equally important. If conditions are favourable "paddy soils" are estimated to develop in 50 to 100 years (14).

The formation of "paddy soils" has been observed on Alluvial soils (3,5,13,

16,20), Grumosols (5), Latosols (3,5), Andosols (5,6) and Regosols (5). These are the main soil groups on which wet land rice is grown. To a lesser extent "paddy soils" are also known to occur on Red-Yellow Podsolic soils (6,20), Gray Hydromorphic soils (5,11,17), Planosols (5,6,20) and Gray Brown Podsolic soils (20). The properties of these soils are strikingly different and references can be made to the literature listed at the end of the paper for their descriptions. A few comments on the "paddy soil" development of the main soil groups are given below.

The alluvial soils, which consist of young marine and river deposits, occupy the major part of the wetland rice areas. Due to their topographic position, groundwater level is high. When very poorly to poorly drained, the whole soil is in a reduced condition and special features due to irrigation do not show. When imperfectly to moderately well drained, the profile shows two mottled horizons, one formed by surface water and the other by groundwater. It should be stressed that the presence of groundwater and the occurence of the two mottled horizons are not the common characteristics of all "paddy soils". This is due to the dominance of alluvial soils in most rice lands. Alluvial soils vary widely in texture, colour, pH and base status according to the source of the material. For rice cultivation, soils of heavy to medium texture are most commonly used; pH may range from strongly acid to alkaline. An example of a colour sequence may be light brownish gray (2,5Y 6/2)[1] in the reduced surface horizon, a yellowish red and black mottling in the accumulated layer, and a pale brown (10YR 6/3) oxidized layer, on the top of which brownish yellow (10YR 5/8) mottles indicate the fluctuating zone of the groundwater.

The Grumosols – also called Regur soils or black tropical soils, used for wetland cultivation – have a level to a rolling relief and are generally formed from marine clays, lime materials or marls. These soils have a heavy clay texture, crack deeply and form a mulchy granular structure at the surface when drying. They are characterised by a thick darkened (10YR 2/1-3/1) surface, relatively low in organic matter. These soils are neutral to alkaline and may contain free lime, partly in the form of concretions. When moistened the clay swells, the soil becomes sticky, plastic and almost impervious. Under irrigation the upper part of the dark horizon looses structure and becomes light coloured (10YR 4/1-5/1), and black (10YR 2/0) manganese spots and streaks form in fissures and root passages. Iron accumulation seldom occurs in these soils.

The Latosols occur in sloping topography and are terraced when used for wetland rice cultivation. These soils are deeply weathered and strongly leached, showing an accumulation of sesquioxides when silica is leached out. They are mostly of heavy texture having, however, a favourable structure and a good permeability. Soil colour is often reddish. Organic matter content, base

1. *Munsell Colour Charts notations for moist samples (19)*

saturation and pH are low. Morphological changes due to irrigation show very clearly in Latosols. The surface layer turns brown (7,5YR 5/4-4/4), looses its friable consistence and crumbly structure, and becomes massive. The yellowish red (5YR 5/8) iron accumulation distinctly overlies the black (10YR 2/0) manganese precipitate, forming a pan when the profile is fully developed. The subsoil shows a bright colour, e.g. reddish brown (5YR 3/4) or red (2,5YR 4/6), and a favourable physical condition of the original soil.

The Andosols are characterized by a thick, crumbly, very dark gray brown (10YR 3/2) surface layer, rich in organic matter, medium to light textured, porous and fairly acid. Occurring in undulating to hilly country, they have to be terraced when used under irrigation. It has been noticed that, in certain areas, organic matter layers are kept apart and spread uniformly over the terrace once it is levelled. When flooded part of the organic matter is decomposed, colour becomes light brown (10YR 4/3) and iron and manganese accumulate in the form of concretions, especially when the soil contains a coarse sand fraction. Pan formation occurs more seldom than in Latosols.

The Regosols used for wetland rice cultivation are commonly composed of volcanic ash. The unconsolidated and porous material is light to medium textured, showing no profile development. A certain stratification may occur due to successive deposits. Colour depends on the composition of the ash. The influence of irrigation shows best in materials containing weatherable and iron rich minerals. Colour becomes lighter in the surface horizon, e.g. gray (10YR 5/1) overlying the dark gray (10YR 4/1) parent material. The accumulation of iron-manganese forms concretions or a slightly cemented pan.

IV. CLASSIFICATION

According to present trends in soil classification, the soil units are distinguished by a set of observable and measurable characteristics, which reflect soil forming processes and have significance for plant growth, soil management and other improvement activities connected with land use.

Regarding the higher classification of the "paddy soils", the light coloured surface horizon fits the definition of an A2 horizon being a surface or a subsurface horizon usually lighter in colour than the underlying horizon which has lost clay minerals, iron or aluminium, or all three, with the resultant concentration of the more resistant minerals (19). The accumulation of iron and manganese, however, does not correspond to the definition of a B2 horizon which is a sub-horizon of maximum accumulation of clay or of iron in combination with organic matter (19). In certain soils a clay migration has been observed but it is not thought to be due to the influence of submersion. However, this condition may hasten clay migration in soils in which it already started, e.g. in Red-Yellow Podsolic soils (6). The surface horizon of "paddy soils" also fits the description of a gley horizon, which is a

layer of reduction characterized by the presence of ferrous iron and involving saturation with water for long periods in the presence of organic matter. In the case of artificial flooding, however, the position of the water table is upside down when compared to normal conditions, but in fact the process is the same as for a gley formed by a fluctuating groundwater table. It is therefore suggested that "paddy soils" be considered as hydromorphic soils rather than as podsolic soils. Since the development of the surface gley does not generally reach more than 30 centimeters deep, it is obvious that the underlying horizons of the original soil cannot be disregarded. "Paddy Soils" could be classified with the hydromorphic associates of the groups of soils on which they have been formed. In case this could be accepted, the definition of these hydromorphic associates would have to be adapted, as the surface gley layers do not always show the neutral colours which are presently used as criteria.

Regarding the lower classification, depth, development and morphology of the reduced surface layer and of the accumulation horizon will have to be taken into account. Implications on drainage conditions, rooting depth and nutritive status will have to be studied so as to define the permissible range of the characteristics to be chosen as criteria. For Japanese conditions a detailed scheme was set up for the lower classification of "paddy soils" according to groundwater table (12).

V. SOIL-WATER-PLANT RELATIONSHIPS

Plant growth is strongly influenced by the submersion of the soil and by the chemical and physical properties it acquires under artificial flooding.

The chemical conditions in the reduced surface layer can be summarized as follows: anaerobic decomposition of organic matter, low oxygen tension, high concentration of carbon dioxide and ammonia, reduction and migration of iron and manganese compounds, reduction of sulfates and nitrates respectively to sulfides and nitrogen, formation of hydrogen sulfide, increase of pH (ferrooxide being a stronger base than ferrioxide and hydrogen sulfide being a weaker acid than sulfuric acid), increase solubility of silica.

A most important feature is the formation of hydrogen sulfide which harms plant growth by inhibiting uptake of nutrients and inducing root developments. Sulfides, however, combine with ferrous iron so that their harming effect may be neutralized if sufficient iron is present. Excess of hydrogen sulfide or of ferrous iron is known to cause physiological diseases related to "browning disease" (Ceylon), "mentek" (Java), "penjakit merah" (Malaya) (7,16,18). The reduction of naturally occuring ferric phosphates is likely to increase the availability of phosphorus to the plant; it seems also favoured by the increased solubility of silica. With the downward movement of iron and manganese compounds, a temporary excess due to higher solubility may be followed by a marked shortage of these elements. Manganese deficiencies in "paddy soils" have been repeatedly mentioned. As the iron requirements of rice

seem to be higher than for most other crops, shortage of iron is harmful, especially when it fails to neutralize hydrogen sulfide.

From a physical standpoint, consequences of a pan formation are impeded drainage and limited rooting depth. The upholding of the water table decreases the water consumption but poor drainage increases the reduction range. There is evidence that the production of rice increases with greater depth of the compact horizon (8). Crops grown in rotation with rice also show the unfavourable influence of the pan formation.

These features, common to all "paddy soils", occur in different degrees and have different bearings on management, according to the original soil on which they have developed.

In Latosols, organic matter content being low and internal drainage good, reduction is favoured by low pH. Although the hydrogen sulfide produced is neutralized by iron which is abundant in these soils, it should be avoided to use acid fertilizers, especially sulphates. When pan formation starts, drainage becomes poor, structure declines and the reduction process is speeded up. An appreciable loss of iron takes place which can be observed from the reddish jelly like lateral outflow along the brims of the terraces. In this case the use of lime may be recommended. Since the clay minerals of the Latosol are of the kaolinitic type, special attention has to be given to phosphate supply as kaolinite is known to fix a very high percentage of the applied doses. As Latosols are relatively low in silica, application of slag as phosphatic fertilizer has proved very favourable (16). Rotation of paddy with dry crops has shown increased rice yields probably due to the interruption of the reducing conditions by aeration of the soil and improvement of structure by the rooting system. Besides mobilization of nutritive elements, the effect of green manure is also thought to be due to aeration. Interruption of the reducing stage can most efficiently be reached by rotational irrigation. With Latosols, which mostly occur in the humid tropics, water supply is partly assured by rainfall. Intermittent irrigation has proved to give higher yields and at the same time enables to increase the irrigated area by a better distribution and conservation of the water (1,2,9).

With Grumosols, organic matter content being low and pH high, reduction is especially induced by the poor internal drainage. The iron content of soils formed from marl is low and is hardly sufficient to neutralize the hydrogen sulfide produced. This explains how, e.g. in Java, the incidence of the "mentek" disease is much higher on Grumosols than on Latosols (21). The use of iron containing or silt bearing irrigation water, e.g. flowing down from a Latosol area, is favourable. In similar cases, the application of iron compounds has been encouraged in Japan. The high pH decreases the availability of phosphates and of some vital trace elements. Special attention should be paid to the latter because manganese deficiencies are common. The use of acid fertilizers is recommended but the sulphate forms should be avoided. Abundant application of organic

matter, which is conducive to the formation of hydrogen sulfide, is questionable on these soils. Grumosols often have a high magnesium content which is known to decrease the availability of potassium. Interruption of the reducing stage and restoration of surface structure by rotation with dry land crops, and eventually by green manure are especially recommended on Grumosols. The difficult workability in the dry season is a limiting factor and attention should be given to the crops suitable for dry cultivation. Intermittent irrigation can also be advocated, but would have to be practised with more caution than on Latosols. As the climate under which these soils occur is dry and in order to avoid cracking of the surface on drying, which causes a tearing of the root system, intervals of irrigation will be short. In addition, intermittent irrigation may increase salinity harzards.

By applying the same fundamental principles, similar studies could be made on the "behaviour" of the other soil groups. However, the examples just given, which indicate the difference between "paddy (Lato) soils" and "paddy (Grumo) soils", may suffice to show that soil-water-plant relationships in "paddy soils" are specific and vary in accordance with their individual properties.

VI. CONCLUSION

Within the framework of international cooperation for the improvement of rice production, much attention has been given to fertilization, manuring and irrigation practices. Although considerable information is now at hand, it is reported (7) that specific knowledge is not yet precise enough, that advices extended on basis of experiments or analyses do not always give the expected results in the field, that there is still considerable difference in opinion on the efficacy of different plant nutrient carriers and on the best time and method of their application, and that an exchange of data between different countries meets with the difficulty of making results comparable.

It is felt that many of these problems could more easily be solved if they were tackled in the realm of well defined environmental conditions, of which the soil is an important factor. It is indeed clear that advices for fertilization and irrigation practices, application of experimental results, exchange of data and cooperative study on growth conditions may reach their full value only if the areas to which they apply are sufficiently homogenous.

In view of the present situation, a systematic study of "paddy soils" would not be pertinent. The purpose of the paper is to call attention to:

1. The great diversity of "paddy soils" and the implications on their management;

2. the desirability of making precise reference to soil conditions in all attempts at the improvement of rice production;

3. the importance of a unified classification and nomenclature of "paddy soils" and of an appraisal of the distribution of the different soil units;

4. the difference in chemical properties between dry and waterlogged soil samples and its bearing on the interpretation of analysed results; and
5. the necessity of a more specific approach to the study of soil-water-plant relationships.

References:

1. Bulanadi, J. and Aldaba, P.B., Effects of Water Depth on the Growth and Yield of Lowland Rice. International Rice Commission News Letter, Vol. VII, No. 1, Bangkok, 1958.

2. Chow, L., Rotational Irrigation for Rice – a Revolution in Taiwan. International Rice Commission News Letter, Vol. VII, No. 1, Bangkok, 1958.

3. Cline, M.G., Soil Survey Report, Territory of Hawaii, U.S.D.A., Soil Survey Series, 1939, No. 25.

4. Chaklader, M.N., Influence of Soil Moisture on the Yield of Paddy. Indian Journ. Agric. Sc., 6, 1946.

5. Dudal, R. and Soepraptohardjo, M., Soil Classification in Indonesia. Gen. Agric. Res. St., Bulletin No. 148, Bogor, 1957.

6. Ellsworth Springer, M., Reconnaissance Soil Survey of Japan, Shikoku. Gen. Headqu. Supr. Command Allied Powers, Natural Resources Section, Report No. 110, D., Washington, 1950.

7. FAO Report of the Joint Meeting of the Three Working Groups of the International Rice Commission held at Vercelli, Italy, 1957.

8. Fu, H.D. and Wang, T.T., Amelioration of Red Earths: III. Preliminary observations of morphological changes of red earth after rice cultivation. Abstract in Bibliography of Rice Soils and Fertilizers, CAB/FAO Publication, Rome, 1954.

9. Go Ban Hong, Penjelidikan Tentang Neratja Hara Mineral dari Padi Sawah (On the Mineral Nutrition of Lowland Rice). Pemb. Balai Besar Penj. Pert., No. 150, Bogor, 1957.

10. Hou, K.C. and Ma, Y.T., On the Morphological Aspects of the Podsolic Rice Paddy Soils. In Thorp, J. (20).

11. Kamoshita, Y., Soil Types in Japanese Paddy Rice Fields. Thans. Fifth Int. Congr. Soil Sc., Vol. IV, Leopoldville, 1954.

12. Kanno, I., A Scheme for Classification of Paddy Fields in Japan with Social Reference to Mineral Paddy Soils. Bul. Kyushu Agric. Exp. St., Vol. IV, 1956.

13. Kanno, I., Tokudome, S., Honjo, Y. and Arimura, S., Pedological

Studies of Paddy Soils in Kyushu, Part I and II, Bul. Kyushu Agric. St., Vol. IV, 1956.

14. Kawaguchi, K. and Matsuo, Y., Movements of Active Oxide in Dry Paddy Soil Profiles. Rap. Six. Congr. Int. Sc. So., Vol. C, Paris, 1956.

15. Koenigs, F.F.R., A "Sawah" Profile near Bogor. Gen. Agric. Res. St., Bulletin No. 105, Bogor, 1950.

16. Mitsui, S., Inorganic Nutrition, Fertilization and Soil Melioration for Lowland Rice. Yokendo Ltd., Tokyo, 1954.

17. Pendleton, R.L. and Sarot Montrakun, Soils of Thailand. Thailand, Past and Present. Publicity Com., Ninth Pacific Sc. Congr., Bangkok, 1957.

18. Ponnamperuma, F., Bradfield, R. and Peach, M., The Chemistry of Submerged Soils in Relation to the Growth of Rice. Rap. Six. Congr. Int. Sc. Vol. C., Paris, 1956.

19. "Soil Survey Manual", Agric. Handbook, No. 18, Soil Survey Staff, U.S.D.A., Washington, 1951.

20. Thorp, J., Soil Changes Resulting from Long Use of Land in China. Am. Soil Sc. Soc. Proc., 1939.

21. Van der Vecht, J., The Problem of Mentek Disease in Java. Landbouw, No. 25, Buitenzorg, 1953.

NATURAL CROSS-POLLINATION IN RICE IN MALAYA

F.B. Brown[1]

I. INTRODUCTION

The inflorescence of the rice plant consists of a terminal panicle of hermaphrodite flowers and the dehiscence of the anthers takes place just before or simultaneously with the opening of the glumes. Self-pollination would therefore appear to be the method by which fertilisation is normally effected, but the existence of a certain amount of cross-pollination has been demonstrated in various countries and under varying conditions. A knowledge of the degree of cross-pollination is of importance in breeding work in that it enables the breeder to grow material in such a way that natural crossing is minimised or eliminated and it also finds use in the planning of effective roguing.

In a previous experiment Larter (1) estimated that the amount of natural cross-pollination in wet padi in Malaya was of the order of one per cent. The interpretation of the results of his experiment was somewhat limited by the non-availability of completely homozygous material. Such material has since been produced and the experiment was repeated with special emphasis given to the creation of conditions favouring natural cross-pollination and to the elimination of factors leading to excessive experimental error.

II. MATERIALS AND METHODS

All varieties used, though thought to be homozygous, were further inbred for five generations by bagging individual plants at flowering time. The experimental material could therefore be assumed to be homozygous. As before, the female parents used were the pure line varieties Nachin 11, Siam 29, Milek Puteh 9 and Reyong 6. All are characterised by the absence of pigmentation in both vegetative and reproductive organs and all produce normal, white, vitreous rice. Awns are not present in any of them. Distinction can be made between these varieties by grain size and shape and by vegetative habit.

The male parents were also the same as in the previous experiment. All are little-known varieties, but all exhibit characters which are believed to be simple Mendelian dominants, such as pigmentation and presence of awned lemmae. Distinguishing features of both male and female parents are summarised in Table 1.

1. *Senior Botanist, Department of Agriculture, Kuala Lumpur, Malaya.*

Table 1. *Pigmentation of Parents*

Organ	Female Parents	Male Parents			
		Kedudok	Janda Mengikut	Merah Isi	Pulut Agam	Kelopak
Pulvinus	–	–	–	x	–	x
Internode	–	–	x	–	–	x
Glume	–	–	x	x	x	x
Lemma	–	x	x	x	x	–
Apiculus	–	–	x	x	x	x
Pericarp	–	x	–	x	–	x

x = pigmented
– = no pigmentation

In addition, all varieties except Kelopak are awnless and the endosperm of Pulut Agam is glutinous while those of the remainder are the vitreous type. Seed of all varieties was also hand-picked before sowing in order to eliminate any obvious rogues and diseased or imperfect grains.

The experiment was planted in ear rows of forty-two plants per row. Plants were 12 in. apart in the rows and there was a spacing of 18 in. between rows. These distances are the ones normally used in pure line selection work in Malaya. In order to ensure that natural cross-pollination would be given a chance to take place, a systematic layout was used. This was as follows:

Row 1 All Kelopak
Row 2 Alternate plants of Kelopak and Nachin 11
Row 3 All Kelopak
Row 4 Alternate plants of Kelopak and Siam 29
Row 5 All Kelopak
Row 6 Alternate plants of Kelopak and Milek Puteh 9
Row 7 All Kelopak
Row 8 Alternate plants of Kelopak and Reyong 6
Row 9 All Kelopak.

This was repeated with the other male parents, giving a total of 45 rows. It will be noted that each female parent plant was surrounded by eight male parent plants.

In order to synchronise flowering, Kedudok was sown on the 12th August and the other varieties on the 29th July. Seedlings were transplanted when 35 days old. Normal growing conditions were experienced, but Merah Isi was badly attacked by rats at tillering time and consequently flowered much later than the other varieties. The nine rows in which it featured were, therefore, discarded. Flowering took place between the 28th December and the 10th January in favourable conditions with no rain in the mornings and only light showers before nightfall. All female plants were harvested, those from the same rows being bulked together.

The following season, random samples of seed were taken from each bulked sample and the F_1 generation was grown as six rows of fifty plants of each cross. Seed of the Siam 29 plants which had been grown in proximity to Kelopak was damaged during storage and was not planted.

III. RESULTS

During the growing season, rats caused damage to most lines and those plants which were badly affected were not harvested. Results from the F_1 plants (see Table 2) of the unpigmented varieties were as follows:

Nachin 11

Rows 1 to 6 (Kelopak). Three plants were off-types, one with the Nachin grain type but having a coloured apiculus and two with a red pericarp.

Rows 19 to 24 (Pulut Agam). Two off-types, one identical with Pulut Agam and most probably a rogue and the other having the grain shape of Pulut Agam but with vitreous endosperm.

Rows 43 to 48 (Janda Mengikut). No off-types.

Rows 67 to 72 (Kedudok). No off-types.

Milek Puteh

Rows 7 to 12 (Kelopak). Two off-types, both with pigmented apiculus and pericarp but otherwise similar to Milek Puteh 9. Both probably hybrids.

Rows 31 to 36 (Pulut Agam). One off-type with a pigmented apiculus - a probable hybrid.

Rows 55 to 60 (Janda Mengikut). No off-types.

Rows 79 to 84 (Kedudok). Fifteen off-types. Thirteen identical with Siam 29 and one identical with Reyong 6, all considered rogues; one probable hybrid with the characters of Milek Puteh 9 but with a coloured apiculus.

Reyong 6

Rows 13 to 18 (Kelopak). Five off-types. Three with pigmented apiculus and pericarp and with grain shape intermediate between Reyong 6 and Kelopak – therefore hybrids; two identical with Kelopak, so considered to be rogues.

Rows 37 to 42 (Pulut Agam). One off-type identical with Siam 29 – a rogue.

Rows 61 to 66 (Janda Mengikut). One off-type identical with Kelopak – a rogue.

Rows 85 to 90 (Kedudok). Two off-types with greyish grains and pigmented pericarp but otherwise like Reyong 6 - hybrids.

Siam 29

Rows 25 to 30 (Pulut Agam). Eleven off-types identical with Reyong 6 and considered to be rogues.

Rows 49 to 54 (Janda Mengikut). Two off-types, one having a pigmented apiculus and grain but with the intensity of pigmentation much less than in Janda Mengikut–hybrid–and one plant identical with Reyong 6 – a rogue.

Rows 73 to 78 (Kedudok). Five off-types, one similar to Siam 29 but with pigmented pericarp–hybrid–and four identical with Nachin 11 – rogues.

These results are summarised in Table 2.

An F_2 generation which was grown subsequently confirmed the validity of the assumptions made as to the nature of the off-types of the F_1 generation.

IV. CONCLUSIONS

The degree of out-crossing which occurred under the conditions of this experiment can be expressed as 15/3691 or 0.41 per cent. Steps were taken to eliminate all factors which were likely to influence the true percentage, and it is therefore concluded that the figure is reasonably accurate. It corresponds well with the degree of hybridity found by Larter (0.48 per cent) and workers in Ceylon. It is surprising, however, that in spite of all precautions taken nearly one per cent of all the plants were rogues. One can therefore presume that in trials conducted under normal conditions a much higher percentage of rogues can be expected. The great necessity of a thorough roguing of seed plots is apparent.

There is also some indication that varieties differ in their susceptibility to out-crossing. The variety Kelopak has given rise to 100 per cent more hybrids than any of the other three male parents used. Such an occurrence has been noted by other workers who have also found differences in different localities. This is a point worthy of future investigation in Malaya.

Reference

1. Larter, L.N.H. (1950): "Natural Cross-Pollination of Wet Padi in Malaya". Malay. agric. J., 33, 82.

Table 2. Occurrence of Off-Type Plants in the F_1 Generation

Varieties	Row Nos.	Surrounding Plants in Previous Year	No. of Plants Harvested	Per Cent			Off-Types	
				Hybrids	Out-Crossing	Rogues	Total	Per Cent
Nachin 11	1–6	Kelopak	252	3	1.19	–	3	1.19
	19–24	Pulut Agam	244	1	0.41	1	2	0.82
	43–48	Janda Mengikut	234	–	–	–	–	–
	67–72	Kedudok	231	–	–	–	–	–
		Total	961	4	0.42	1	5	0.52
Milek Puteh 9	7–12	Kelopak	220	2	0.91	–	2	0.91
	31–36	Pulut Agam	241	1	0.42	–	1	0.42
	55–60	Janda Mengikut	241	–	–	–	–	–
	79–84	Kedudok	265	1	0.38	14	15	5.66
		Total	967	4	0.41	14	18	1.86
Reyong 6	13–18	Kelopak	268	3	1.12	2	5	1.87
	37–42	Pulut Agam	268	–	–	1	1	0.37
	61–66	Janda Mengikut	225	–	–	1	1	0.44
	85–90	Kedudok	277	2	0.72	–	2	0.72
		Total	1,038	5	0.48	4	9	0.87
Siam 29	25–30	Pulut Agam	256	–	–	11	11	4.30
	49–54	Janda Mengikut	235	1	0.43	1	2	0.86
	73–78	Kedudok	234	1	0.43	4	5	2.14
		Total	725	2	0.28	16	18	2.49
		Grand Total	3,691	15	0.41	35	50	1.35

THE SIXTH SESSION OF THE INTERNATIONAL RICE COMMISSION

to be held in

Tokyo, Japan, 3-4 October 1958

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The coordination of these two meetings will be of distinct advantage to participating Member Governments and FAO through the resulting savings and in giving the Regional Conference the possibility of reviewing the policy aspects of the decisions taken by the International Rice Commission.

Provisional Agenda

1. Opening of Session
2. Election of Officers
3. Introductory Statements
4. Adoption of Agenda.
5. Report on Past Work and Outline of Work for the Future.
   a. Introduction of Reports and Financial Statement.
   b. Rice Production and Protection.
   c. Rice Soils, Water and Fertilizer Practices.
   d. Agricultural Engineering Aspects of Rice Production, Storage and Processing.
6. Future Organization of the International Rice Commission and of the Technical Working Bodies and Possible Arrangements and Schedules for Future Meetings.
7. Constitution and Procedural Considerations and Related Principles.
8. Other Business.
9. Plans for the Next Meeting.
10. Adoption of Report.

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REPORTS OF THE COMMISSION AND ITS WORKING GROUPS

Reports of the Commission

Report of the First Session, Bangkok, Thailand, March 1949
Report of the Second Session, Rangoon, Burma, February 1950
Report of the Third Session, Bandung, Indonesia, May 1952
Report of the Fourth Session, Tokyo, Japan, October 1954
Report of the Fifth Session, Calcutta, India, November 1956

Reports of the Working Party on Rice Breeding

Report of the First Meeting, Rangoon, Burma, February 1950
Report of the Second Meeting, Bogor, Indonesia, April 1951
Report of the Third Meeting, Bandung, Indonesia, May 1952
Report of the Fourth Meeting, Bangkok, Thailand, September 1953
Report of the Fifth Meeting, Tokyo, Japan, October 1954
Report of the Sixth Meeting, Penang, Malaya, December 1955

Reports of the Working Party on Fertilizers

Report of the First Meeting, Bogor, Indonesia, April 1951
Report of the Second Meeting, Bandung, Indonesia, May 1952
Report of the Third Meeting, Bangkok, Thailand, September 1953
Report of the Fourth Meeting, Tokyo, Japan, October 1954
Report of the Fifth Meeting, Penang, Malaya, December 1955

Report of the ad hoc Working Group on the Problems of Mechanization of Rice Production under Wet Paddy Conditions

Report of the First Meeting, Peradeniya, Ceylon, May 1956

Report of the ad hoc Working Group on the Problems of Storage and Processing of Rice

Report of the First Meeting, Calcutta, India, November 1956

Report of the ad hoc Working Group on the Problems of Soil, Water and Plant Relationships in the Production of Rice

A Preliminary Report by Correspondence, November 1956

Joint Report of the Seventh Meeting of the Working Party on Rice Breeding; the Sixth Meeting of the Working Party on Fertilizers; and the First Meeting of the ad hoc Working Group on Soil-Water-Plant Relationships

Held at Vercelli, Italy, September 1957.

PRINTED AT PRACHANDRA PRESS, MAHARAJA ROAD,
BANGKOK, THAILAND.
MR. SANAN BUNYASIRIBHANDHU.
PROPRIETOR, PRINTER AND PUBLISHER.
1958